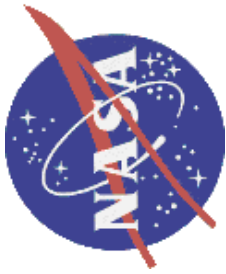


REAL-TIME AFFECTIVE INDICES OF POTENTIAL CRM BREAKDOWN: QUALITATIVE TESTING OF AN OPERATIONAL HYPOTHESIS

Mark Dickerson

NASA Dryden

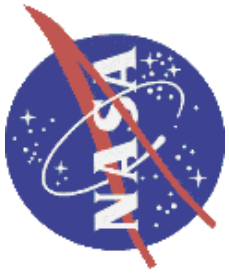




or...

Recognizing CRM
Breakdown is Like Trying to
Give Yourself CPR



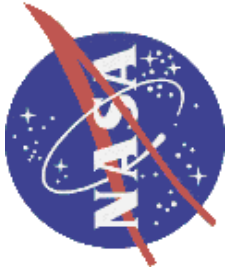


The Bad News: Some may be headed for a smoking hole!

Good News: We're not there yet.

- What this is NOT about: No CRM Tutorial
- Brief Rundowns of Several Mishaps
- An Unproven Hypothesis: What if...?
- Real-Time R&D, Right Here, Right Now
 - Get on Same Page with Some Definitions
 - A 10-Minute Group Research Project
- Way to make use of the Results

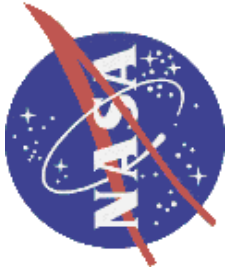




Air Florida 90 (1982)

- Flight to Fort Lauderdale, from Washington National
- Departure was delayed about 1 hour 45 minutes due to snowfall
- Takeoff was made with snow and/or ice adhering to the aircraft, the aircraft crashed into the 14th Street Bridge, and plunged into the Potomac River.
- The NTSB determined that the probable cause of this accident included the flight crew's decision to take off with snow/ice on the airfoil surfaces of the aircraft.





American 1420 (1999)

- Approached during CBs
- Overran the end of runway and struck the instrument landing system localizer array,
- NTSB determined that the probable causes of this accident included the flight crew's failure to discontinue the approach when severe thunderstorms and their associated hazards to flight operations had moved into the area



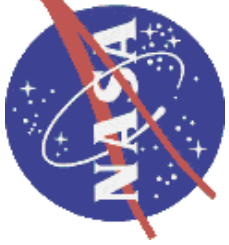


Air China 129 (2002)



- The Flight departed Beijing on a flight to Pusan-Gimhae in South Korea.
- Weather required a circling approach which none of the crew members had flown
- The captain took over control from the first officer and said he was going to turn base, but due to the limited visibility they were not able to see the runway.
- The aircraft impacted a mountain, about 4.6 km from the runway.
- Korean Accident Investigators concluded that, among other causes, the flight crew exercised poor crew resource management and lost situational awareness during the circling approach

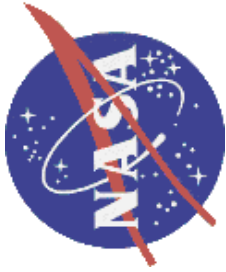




F-16 MALD Photo Chase(2001)

- Experienced pilot and photographer assigned to chase MALD
- Performed extended maneuvers to maintain photo coverage after stores drop
- Pitch attitude reached as much as 70 to 90 degrees nose low
- Aircraft impacted the terrain wings level in approximately 15 degree decent at approximately 8 g's





FedEx 647 (2003)

- FedEx flight 647, a Boeing MD-10, crashed during a crosswind landing at Memphis. The right main landing gear collapsed after touchdown and the airplane veered off the right side of the runway.
- The post-crash fire destroyed the airplane's right wing and portions of the right side of the fuselage.
- The NTSB determined that the probable causes of the accident included the captain's failure to adequately monitor the first officer's performance and command or initiate corrective action during the final approach and landing.





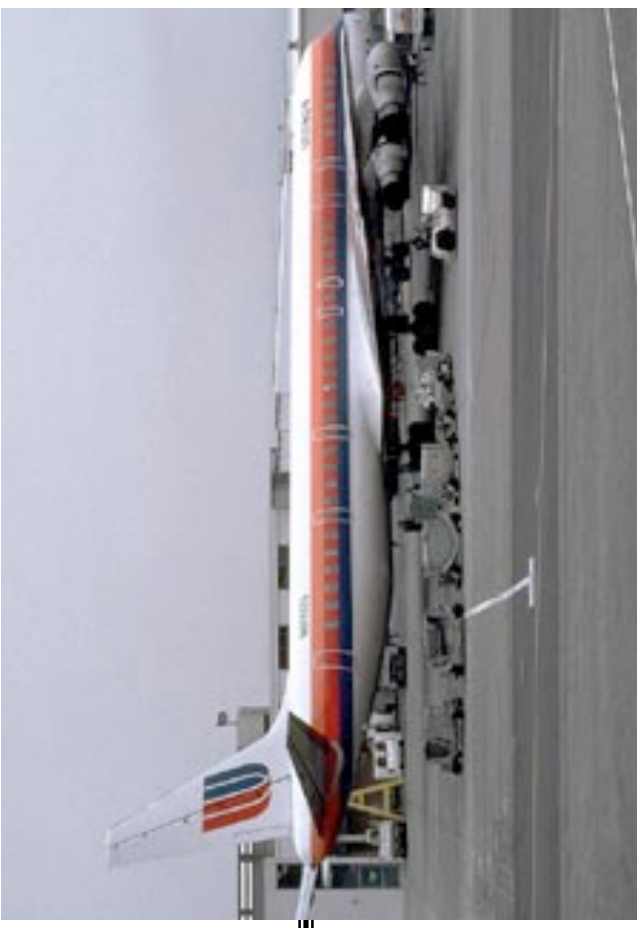
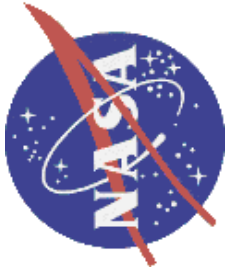
Challenger C-FTBZ

(2000)



- A Canadair Challenger was destroyed on impact with terrain during initial climb. The pilot and flight test engineer were killed. The copilot was seriously injured and died 36 days later.
- The PIC in the left seat was flying the takeoff. The cards called for a standard takeoff and climb followed by testing of a modified pitch feel system.
- The NTSB determined that the probable causes included the pilot's excessive takeoff rotation and subsequent rearward shift in the airplane's c.g. beyond the aft limit. The plane stalled too low TO recover.

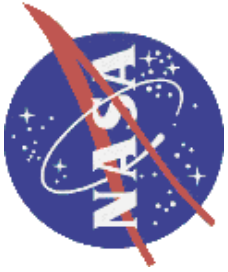




United 173 (1978)

- Flight was a DC-8 enroute from NYC to Portland, Oregon via Denver.
- The aircraft had delayed at low altitude for about one hour in the Portland area in an attempt to cope with a landing gear malfunction.
- It ran out of fuel and crashed in a wooded area southeast of Portland.
- The NTSB concluded that the probable causes of the crash included the captain's failure to properly respond to crew advisories regarding the fuel state.

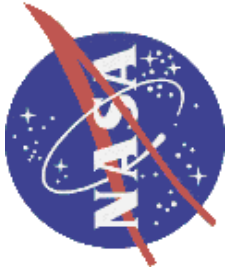




Southwest 1455 (2000)

- The flight, a Boeing 737-300, overran the departure end after landing at Burbank, California.
- The airplane touched down at approximately 182 knots, eventually collided with a metal blast fence and an airport perimeter wall, coming to rest in a gas station just outside the airport boundary.
- The NTSB determined that the probable causes included the flight crew's excessive airspeed and flight path angle during the approach and their failure to abort the approach when stabilized approach criteria were not met.



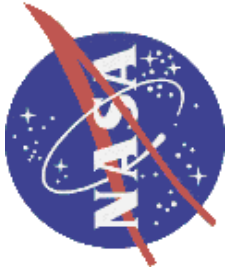


B-1 Wiry 29 (1984)



- B-1A was lost on a test flight at Edwards AFB.
- Aircraft was between test points, CG was aft under manual control
- Previous point had wings swept fully aft, they were transitioning to a point requiring wings fully forward.
- The airplane ran out of pitch stability, pitched up to 70 degrees nose high, and went out of control, leading to activation of escape system.





Okay... so?

- Foreign, Domestic, Military, Civilian, Takeoff, Landing, Flight Test, Commercial, Heavy, Fighter.
- So what's the common thread?
- Most people familiar with these mishaps would conclude that they all involved significant CRM issues.





CRM? - FAA AC-120-51e

- As used in this AC, CRM refers to the effective use of all available resources: human resources, hardware, and information. Other groups are also essential participants in an effective CRM process. These groups include but are not limited to:
 - (a) Aircraft dispatchers.
 - (b) Flight attendants.
 - (c) Maintenance personnel.
 - (d) Air traffic controllers.
 - (e) Flight Test Engineers.
 - (f) Control Room Personnel.





What if...?

- What if there were typical indicators that a crew or control room member could use that might flag the presence of CRM breakdown?
- What if there were also a clear, situation-neutral way to respond when a crew member notices these indicators?
- Let's find out!



**“Hello...? Houston...?
We have a problem...”**





“Basic” Emotions?

Theorist	Suggested “Basic” Emotions
Plutchik	Acceptance, anger, anticipation, disgust, joy, fear, sadness, surprise, love
Arnold adds:	aversion, courage, dejection, despair, hate
Panksepp adds:	panic
Frijda adds:	happiness, interest, wonder, sorrow
Gray adds:	Rage, terror, anxiety
Izard adds:	contempt, distress, guilt, shame
McDougall	elation, subjection, tender-emotion



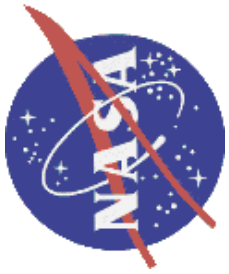


“Cockpit” Emotions

(Source: Dickerson, Anheuser & Busch)

- | | | |
|----------------|---------------|-----------|
| • acceptance | • anger | • panic |
| • admiration | • annoyance | • sadness |
| • elation | • anxiety | • shame |
| • pride | • contempt | • sorrow |
| • relief | • dejection | |
| • resolve | • despair | |
| | • disgust | |
| • amazement | • fear | |
| • anticipation | • guilt | |
| • interest | • humiliation | |
| • surprise | | |

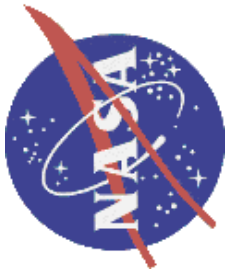




Aviator Mental States (Dickerson)

- Nervous
- Confused
- Frustrated
- Rushed
- Task Saturated
- Intimidated
- Bored
- Disrespected or Insulted
- Self-Righteous
- Contemptuous
- Panic
- Impatience
- Harassed
- Excited
- Distracted
- “Forgetting Something”
- Inadequate
- “Hidden Agenda”
- Threatened
- Muzzled
- Smug
- Defiance





FAA's 5 HAZARDOUS ATTITUDES

Hazardous Attitude	Antidote
Anti-authority: Don't tell me what to do.	Follow the rules. They are usually right.
Impulsivity: Do something quickly.	Not so fast. Think first.
Invulnerability: It won't happen to me.	It could happen to me.
Macho: I'm tough enough. I can do it!	Taking chances is foolish.
Resignation: What's the use?	I'm not helpless. I can make a difference.





Real-Time R&D

- Packages being handed out to you: Don't open!
 - Mishap Brief, List of Mental and Emotional States
- Look at YOUR OWN crew position on that incident and note the PRIMARY mental and emotional states of that crew member WHILE THERE WAS STILL TIME TO AVOID THE MISHAP (Try to avoid 20/20 Hindsight effect)
- Then go back and check any that YOU HAVE ACTUALLY EXPERIENCED during a CRM Breakdown situation. For instance...
- Want a copy? LEGIBLE e-mail at bottom!

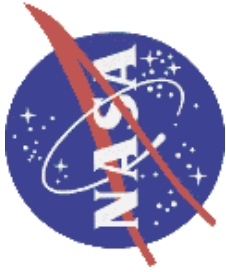




Caveats & Tips!!

- Avoid 20/20 Hindsight! Try to get into the moment, not knowing the outcome.
- Suggestion: Use the margins on the mishap side to note the emotions as they occur.
- Don't go overboard... 6 or 8 is about right.
- BE sure to stick to period **WHILE THERE WAS STILL TIME TO AVOID THE MISHAP**.
- Important emotions may start in the briefing!
- Did I mention?... Avoid 20/20 Hindsight! Try to get into the moment without the benefit of knowing the outcome.

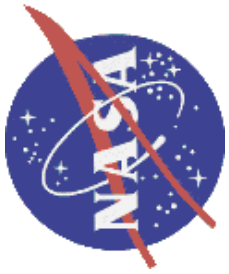




BEGIN THE SURVEY

(QUESTIONS “ON
THE FLY”)

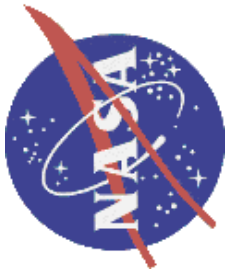




10 MINUTES REMAINING

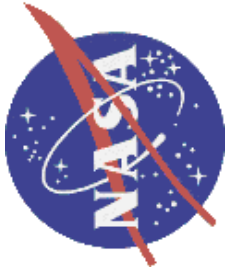
- AGL – above ground level
- ATIS – automated weather report
- CG – center of gravity
- CVR – cockpit voice recorder
- DME – distance measuring equip.
- FE – flight engineer
- FO – first officer
- GPWS – ground prox warnng sys
- ILS – instrument landing system
- IMC – bad weather
- LOC – localizer
- NM – nautical miles
- OFP – operational flight program
- PFS – pitch feel system
- RVR – runway visual range





SURVEY RESULTS:
Total Surveys- 123
Aircraft Captains – 58
Other Crew/Team - 65





RESULTS: Survey Says, “If You Feel This... Re-Assert CRM!”

-
-
- **Aircraft Captains**
 - **58 Total Surveys**
 - Top Emotions and Mental States
 - Rushed, Busy, or Task Saturated – 61 hits
 - Macho, Invulnerable, or Prideful – 44 hits
 - Pressured – 30
 - Annoyed, Frustrated, or Angry – 30
 - Nervous, Fearful, or Anxious – 29 hits
 - Confused or Uncertain – 28
 - **All Others**
 - **65 Total Surveys**
 - Top Emotions and Mental States
 - Nervous, Anxious, or Fearful – 71 hits
 - Rushed, Busy, or Task Saturated – 50 hits
 - Confused or Uncertain – 46 hits
 - Annoyed, Frustrated, or Angry – 37
 - Pressured – 28 hits

SUGGESTION: Put these on the back of your
PACE card.





Okay, so What do I DO about it?

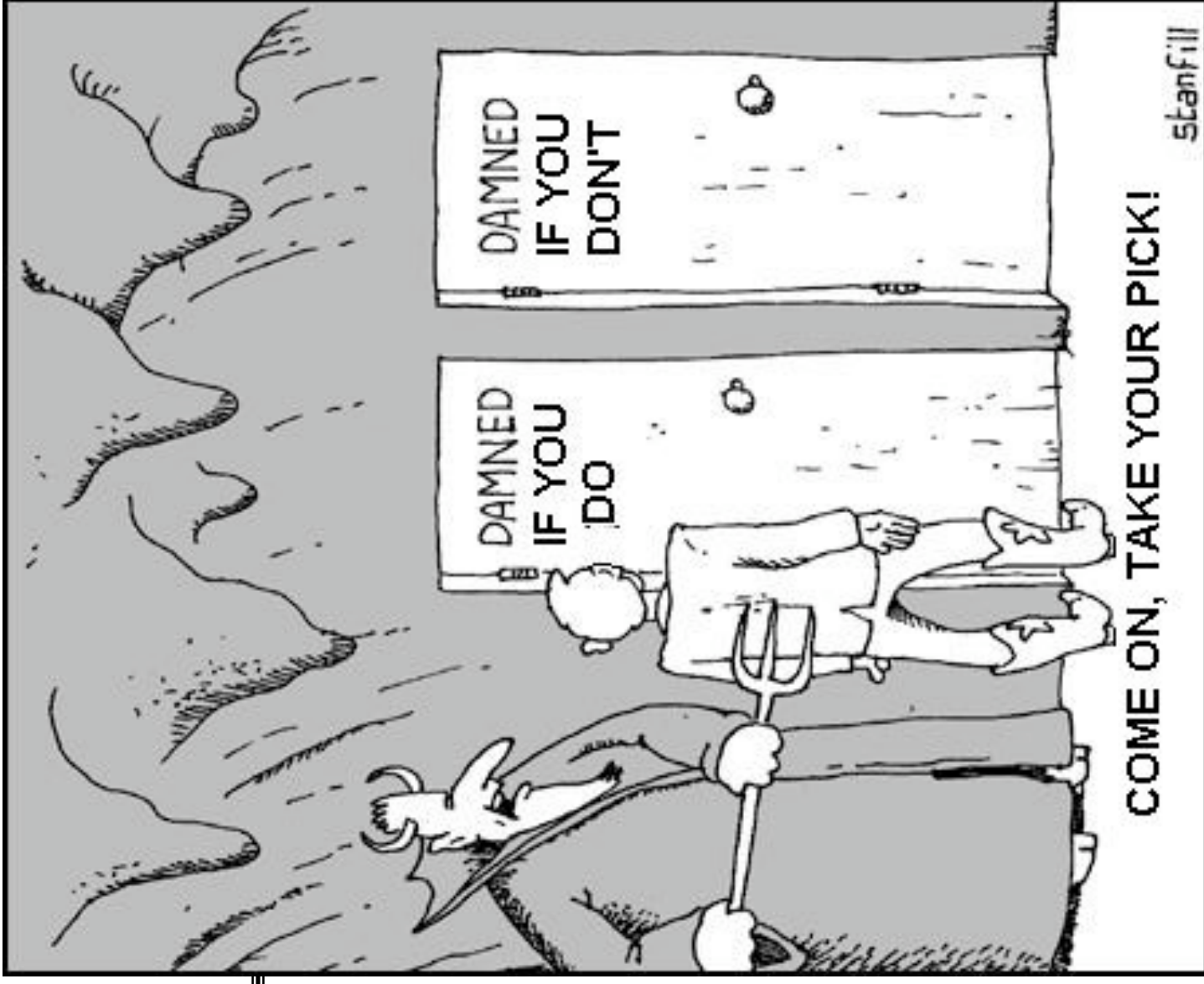
- Pick up the **PACE** (Bob Besco, AA Capt)
- As FTE or PNF: Prepare to go the distance by **knowing the mission rules cold**.
 - **Probe**: “I don’t understand this plan.”
 - **Alert**: “I’m not comfortable with this plan.”
 - **Challenge**: “This plan has a high risk of xyz.”
 - **Emergency Action**: Call “Terminate” or “Abort” or “Congo 16 is RTB due to xyz.” or “I’ve got the aircraft.”
- As Skipper: Don’t let it become a mutiny!

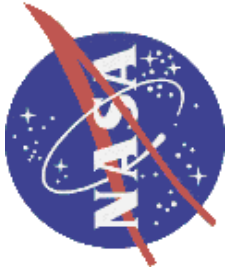




The “Co-Pilot’s Dilemma”

If you’re going to
get in trouble
anyway, you may
as well get in
trouble for doing the
right thing!





A Brief Recap

- Rundowns of Several Mishaps
- A Theory on Real-Time CRM Assessment
- A Mishap-Based Survey to Check Theory
 - Objective: Find Indicators of CRM Failure
 - Method: Ask Diverse Group of Testers
 - Results: Rushed? Pressured? Annoyed? Uncomfortable? WATCH OUT!
- Some Thoughts About Using the Results
 - **P**robe, **A**lert, **C**hallenge, **E**mergency Action

